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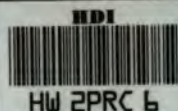
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A LABORATORY GUIDE
FOR THE
DISSECTION OF THE CAT

GORHAM AND TOWER

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A LABORATORY GUIDE
FOR THE
DISSECTION OF THE CAT

AN INTRODUCTION TO THE STUDY
OF ANATOMY

BY

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AND

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INSTRUCTORS IN BIOLOGY IN BROWN UNIVERSITY

Physiology I

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PREFACE

THIS outline has been prepared to supply a convenient laboratory guide for elementary classes in anatomy. It is intended to serve merely as an introduction to anatomical methods and terminology. In its preparation we have been assisted by the suggestions of Dr. H. C. Bumpus, Professor of Comparative Anatomy in Brown University, whose advice we gratefully acknowledge.

BROWN UNIVERSITY,
April 4, 1895.

Physiology I

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INTRODUCTION

EACH student should be supplied with at least one good scalpel, a pair of strong forceps, a pencil, and a note-book. It is expected that the Laboratory will furnish for general use such necessary equipments as bone-forceps, bone-saws, weighted hooks, and dissecting-boards.

Animals can be conveniently kept from day to day by using ice or by injecting two per cent. formalin into the principal vessels and cavities. For convenience in studying the vascular system, however, the blood-vessels should be injected with some colored fluid. For this purpose an ordinary starch injection mass, prepared according to the following formula, may be used : *

Dry starch (laundry)	1 vol.
2½ per cent. aqueous solution of chloral hydrate.....	1 vol.
95 per cent. alcohol	¼ vol.
Color { Dry color..... 1 vol. }	¼ vol.
{ Glycerine..... 1 vol. }	
{ 95 per cent. alcohol.... 1 vol. }	

It will be found advisable to immediately remove the brain from such animals as are used for the dissection of the viscera or muscles in order that the organ may be hardened for later dissection. Brains hardened in a two per cent. solution

* See Whitman's "Methods," p. 223.

of formalin or seventy per cent. alcohol will be found suitable for ordinary dissection. If the formalin or alcohol is injected into the cavities of the brain through the *infundibulum*, better preparations will be secured. The cat's heart and eye will answer for general dissection, but it will be found convenient to substitute the heart and eye of the pig for more extended study. These can be easily obtained from the slaughter-house. The description here given of the heart and eye of the cat serves equally well for the pig, with the exception that the *tapetum* is wanting in the latter animal.

Each student should be provided with the unmounted bones of one specimen for the work of the first chapter. Each of the remaining chapters really requires a fresh and complete animal, though with the exercise of considerable care it is possible to study both circulatory and nervous systems from a single specimen. At least three animals, then, are necessary.

Minute directions for dissection often retard the student more than they aid him, and in this guide only the general method is indicated. The ingenuity of the student, directed by the instructor, will suggest the details. For more exhaustive works on the anatomy of the cat, the student is referred to "Anatomical Technology," by Wilder and Gage, and "The Cat," by Mivart.

The figures are diagrammatic, but will serve to

indicate the more general matters of relative size and position. The nomenclature ordinarily used in standard anatomical literature has been followed. The signification of the general terms of direction is :

Anterior.....toward the head.

Posterior.....toward the tail.

Dorsal.....toward the region of the back.

Ventral.....toward the region of the belly.

Lateral.....toward either side.

Proximal.....toward the central axis of the body.

Distal.....away from the central axis of the
body.

The terms right and left refer to the right and left of the animal being dissected, and not necessarily to the right and left of the dissector.

CHAPTER I

SKELETON

AXIAL SKELETON

A.—Skull. (Plate I., A.)

The **Skull** is the skeleton of the head and is composed of the following bones:

1. The **Occipital Bone**, which forms the posterior part of the skull. It surrounds a large opening, the *foramen magnum*. On either side of this foramen are two smooth articular prominences, the *occipital condyles*. A projecting ridge on the upper margin of the occipital bone is the *lambdoidal ridge*. The *anterior condyloid foramina* pierce the ventral side of the occipital bone a little anterior to the occipital condyles.

2. The **Temporal Bones**, which form the lateral and posterior part of the base of the skull. On its under surface each presents a prominent oval elevation, the *auditory bulla*. On the external side of each bulla is a large foramen, the *external auditory meatus*. Just behind the auditory meatus is a small foramen, the *stylo-mastoid*. Between each bulla and the occipital bone, just in front of the anterior condyloid foramen, is the, somewhat larger,

jugular foramen. From the anterior part of the temporal bone extends a bony arch, the *zygomatic process*. On the under side of this process is a depression for the articulation of the lower jaw, called the *glenoid fossa*.

3. The **Parietal Bones**, which form the upper posterior part of the skull. They meet, above, in the median line.

4. The **Interparietal Bone**, which lies in the mid-dorsal line, between the parietal and occipital bones. It is small and triangular.

5. The **Sphenoid Bone**, which partially forms the base of the skull. It lies in front of the occipital and between the temporal bones. The sphenoid is pierced on either side by two foramina, the posterior of which is the *foramen ovale*, the anterior the *foramen rotundum*.

6. The **Presphenoid Bone**, which lies in the mid-ventral line, immediately in front of the sphenoid. It is pierced on either side by the *optic foramina*. Between the sphenoid and presphenoid bones, in line with the optic foramen and the foramen rotundum, is the large *sphenoidal fissure*.

7. The **Frontal Bones**, which form the anterior part of the roof of the skull, meeting above in the mid-line. On either side each frontal bone presents a sharp process, the *post-orbital*. The cavity behind this process is the *temporal fossa*.

8. The **Malar Bones**, which form the outer inferior margin of the orbits. Each articulates pos-

teriorly with the zygomatic process of the temporal bones.

9. The **Maxillary Bones**, which form the principal part of the upper jaw. Each bears the following teeth : one canine, three premolars, and one molar. It has a posteriorly-directed process which articulates with the malar bone, and is called the *malar process*.

10. The **Premaxillary Bones**, which are two small bones meeting in the mid-line in front of the maxillary bones. Each bears three incisor teeth.

11. The **Nasal Bones**, which lie in the mid-dorsal line above the nasal cavity.

12. The **Lachrymal Bones**, which lie on the anterior walls of the orbits.

13. The **Palatine Bones**, which form the posterior part of the roof of the mouth.

14. The **Vomer**, which forms the lower part of the median partition between the nostrils.

15. The **Ethmoid Bones**, which lie between the frontal bones in the nasal chamber. They are composed in part of many folded lamellæ.

16. The **Turbinated Bones**, which also consist of folded lamellæ, extending into the nasal chamber, from the inner side of the ethmoid and maxillary bones.

17. The **Mandible**, or skeleton of the lower jaw, which consists of two rami meeting anteriorly in the symphysis. The posterior vertical portion of the mandible is known as the *ascending ramus*,

and the remaining portion is the *horizontal ramus*. The highest point of the ascending ramus is the *coronoid process*. The mandible bears on either side the following teeth: three incisors, one canine, two premolars, and one molar. (Plate I., B.)

The dental formula would be: i. $\frac{3}{3}$, c. $\frac{1}{1}$, pm. $\frac{3}{2}$, m. $\frac{1}{1}$.

18. The **Hyoid Arch**, which passes from the under side of the skull to the top of the larynx. It is composed of a *body* and a pair of *anterior* and *posterior horns*. The body of the hyoid is formed by a single bone, the *basi-hyal*, which forms the front part of the upper border of the larynx. Each posterior horn extends around the upper margin of the larynx, and is composed of the *thyro-hyal* bone. Each anterior horn is composed of the *cerato-hyal*, *epi-hyal*, and *stylo-hyal* bones, and the *tympano-hyal cartilage*, which unites with the skull. (Plate I., c.)

B.—Vertebral Column.

The **Vertebral** or **Spinal Column** is composed of seven cervical, thirteen dorsal, seven lumbar, three sacral, and twenty-two caudal vertebræ. Each vertebra is composed of a body and a neural arch enclosing a neural canal and bears on either side a *transverse process* and dorsally a *neural process*. Between adjoining vertebræ, on each side, there is

an *intervertebral foramen* which permits the passage of blood-vessels and nerves to and from the neural canal.

1. The **Cervical Vertebrae** form the skeleton of the neck. The most anterior cervical vertebra, the *atlas*, is somewhat modified to support the skull. It bears on its anterior side two concave articular surfaces which receive the condyles of the skull. Its transverse processes form two wing-like expansions. (Plate I., D.) The second cervical vertebra, the *axis*, is also modified. It bears at its anterior end a pivot, the *odontoid process*, on which the atlas turns. The odontoid process is morphologically the body of the atlas. (Plate I., E.) Each of the six anterior cervical vertebrae are pierced by two foramina, one on either side of the neural canal.

2. The **Dorsal Vertebrae** are characterized by the great development of their posteriorly-directed neural processes. (Plate I., G.)

3. The **Lumbar Vertebrae** are larger, with well-developed transverse processes and anteriorly-directed neural processes. (Plate I., H.)

4. The **Sacral Vertebrae** are more or less completely united together and serve for the attachment of the pelvis.

5. The **Caudal Vertebrae** gradually become smaller and their processes reduced. Certain of the caudal vertebrae bear beneath their anterior ventral surface small *chevron bones*. (Plate I., I.)

C.—Ribs.

The **Ribs** form the bony framework of the thorax. There are thirteen pairs, articulating dorsally with the vertebral column. The nine anterior pairs or *true ribs* are connected with the sternum by costal cartilages. The four posterior pairs or *false ribs* are not united to the sternum. (Plate I., J.)

D.—Sternum.

The **Sternum** is the chain of bones forming the ventral support of the cartilages of the ribs. It consists of eight or nine bones (*sternebræ*), of which the most anterior is the *manubrium*. Posteriorly the sternum ends in the *ensiform cartilage*, which is more or less expanded and extends freely backward. (Plate I., K.)

APPENDICULAR SKELETON.

A.—Shoulder-girdle and Fore-leg.

1. The **Clavicle** is the small bone which does not articulate with any of the bones of the body, but is imbedded in the muscles of the anterior part of the shoulder. (Plate I., L.)

2. The **Scapula** or shoulder-blade is the triangular bone which lies against the side of the thorax. Its dorsal edge is the *vertebral margin*, its ventral edge is the *axillary margin*. Its outer side is divided by a longitudinal ridge of bone, the *spine*,

into a *supra-* and *infra-spinous fossa*. Anteriorly the spine bears two processes, the anteriorly-directed *acromion process* and the posteriorly-directed *metacromion process*. The concave inner surface of the scapula forms the *subscapular fossa*. Anteriorly the scapula ends in a concave articular surface, the *glenoid cavity*. The *corocoid process* is a curved projection extending from the anterior edge of the glenoid cavity. (Plate I., m.)

3. The **Humerus** is the uppermost and largest of the bones of the fore-leg. At its proximal end the humerus has two prominences, of which the outer and larger is the *greater tuberosity*, the inner and smaller is the *lesser tuberosity*. Between the two tuberosities is a rounded surface for articulation with the scapula, known as the *head of the humerus*. Along the anterior side of the upper part of the shaft of the humerus is a slightly roughened elevation, the *deltoid ridge*. The *supra-condyloid foramen* is an elongated opening in the lower part of the humerus. The *olecranon fossa* is a deep depression on the posterior side of the humerus just above its articular surface. (Plate I., n.)

4. The **Ulna** and **Radius** are the two bones which articulate with the humerus at its distal end. The ulna is the larger and has a prominent process, the *olecranon*, extending beyond its articulation with the humerus. Below its articulation with the humerus is the smaller *coronoid process*, which articulates with the radius. (Plate I., o. and p.)

5. The **Carpal Bones** are the seven small bones arranged in two tranverse rows below the ulna and radius.

6. The **Metacarpals** extend distally from the carpals; they are five in number and are considerably elongated.

7. The **Phalanges** are the bones of the toes. Each toe, with the exception of the innermost or *pollex*, has three phalanges. The pollex has only two.

B.—Pelvic-girdle and Hind-leg.

1. The **Pelvis** is formed by the union of the two *innominate bones*; it forms a bony arch to which the hind limbs are articulated. The long upper portion of the pelvis, extending from the articulation with the sacrum to the *acetabulum*, or socket for the articulation of the bone of the thigh, is the *ilium*. The upper anterior convex border of the ilium is the *crest*. The portion of the innominate bone extending backward from the acetabulum and forming the upper and hinder margin of a large oval opening, the *obturator foramen*, is the *ischium*. The blunt process at the posterior angle of the ischium is the *tuberosity*. The remaining portion of the innominate bone, extending from the acetabulum toward the mid-ventral line, where it unites with its fellow of the opposite side, is the *pubis*. The line of union of the two pubes is the *symphysis pubis*. (Plate I., Q.)

2. The **Femur** is the bone of the thigh. It has a rounded *head*, which rests in the acetabulum. External to the head of the femur is a rough elevation, the *great trochanter*. On the posterior side of the femur is a rough line for the attachment of muscles, the *linea aspera*. On the posterior side of the lower end of the femur are two rounded articular elevations, the *external* and *internal condyles*. The *patella* or knee-pan is the small oval bone which is imbedded in the tendon on the anterior side of the lower end of the femur. (Plate I., R.)

3. The **Tibia** and **Fibula** are the two bones of the leg next below the femur. The tibia is the larger bone, and has at its upper end two articular surfaces which receive the condyles of the femur. On either side of these two surfaces are two projections, the *external* and *internal tuberosities*. (Plate I., S and T.)

4. The **Tarsal Bones** are the seven bones of the ankle. The one with which the tibia articulates is the *astragalus*. The largest of the tarsal bones, the bone of the heel, is the *calcaneum*.

5. The **Metatarsals** are five bones which articulate with the tarsals. The four external ones are long and well-developed; the inner one is very small and rudimentary.

6. The **Phalanges** are the bones of the toes. There are three in each of the four toes. The innermost metatarsal or *hallux* has no phalanges.

CHAPTER II

VISCERA

ABDOMINAL VISCERA

Make a median incision through the skin and muscles from the sternum to the symphysis pubis.

1. The **Peritoneum** is the thin, shining membrane lining the abdominal cavity. It is reflected over the viscera.

2. The **Great Omentum** is the apron-like fold of the peritoneum which hangs down from the stomach and covers the viscera. It always contains more or less fat.

A.—Alimentary Canal.

1. The **Œsophagus** passes from the mouth to the stomach. Its posterior end may be seen piercing the diaphragm by pressing aside the lobes of the liver.

2. The **Stomach** is the enlargement of the alimentary canal immediately posterior to the diaphragm and behind the lobes of the liver.

The *Fundus* is the portion of the stomach which lies to the left of the entrance of the œsophagus.

The *Pylorus* is that part of the stomach which opens into the intestine.

The part of the stomach lying to the left is called the *cardiac* portion; that to the right the *pyloric* portion; the anterior margin is the *lesser curvature*; the posterior margin is the *greater curvature*.

The stomach is lined with mucous membrane, which is thrown into folds at the cardiac end.

3. The **Small Intestine** is the convoluted tube which leaves the stomach at the pyloric end. The U-shaped portion immediately succeeding the pylorus is the *duodenum*. The *jejunum* is the direct continuation which runs a short distance to the right. The remaining convoluted mass is the *ileum*, which terminates at the junction with the large intestine. The fold of the peritoneum which suspends the intestines from the body wall is the *mesentery*. Blood-vessels, nerves, and lymphatics pass to the intestine between its two layers.

The mucous membrane which lines the small intestine is raised into a number of closely-set filaments, called *villi*.

4. The **Large Intestine** is the remaining large and less convoluted portion of the alimentary canal. It passes forward, from the junction with the ileum, as the *ascending colon*, across to the left as the *transverse colon*, and backward as the *descending colon*, ending in a terminal portion called the

rectum. The rectum lies in the pelvis and opens to the exterior through the *anus*. The rounded diverticulum of the large intestine which projects beyond the point where the small intestine opens is the *cæcum*.

The mucous membrane lining the large intestine is smooth throughout.

B.—Appendicular Organs of the Alimentary Canal.

1. The **Pancreas** is the long, pinkish body lying in the curve of the duodenum. The pancreas has two ducts opening into the intestine; one in connection with the bile-duct, the other about an inch farther back.

2. The **Liver** is the large, lobulated, red body lying immediately behind the diaphragm. It is suspended from the diaphragm by a fold of the peritoneum, the *falciform ligament*, which divides the liver into a right and left portion. These are usually subdivided into the following lobes, but are subject to variation :

a. The *right central lobe* lies against the right side of the diaphragm. It encloses the *gall-bladder*.

b. The *right lateral lobe* lies posterior to the right central lobe.

c. The *caudate lobe* lies on the posterior side of the right lateral lobe and extends backward to the kidney.

d. The *Spigelian lobe* is the smallest lobe of the liver. It lies in the mid-line and extends into the small curvature of the stomach.

e. The *left central lobe* is small and lies against the left side of the diaphragm.

f. The *left lateral lobe* is large and lies between the left central lobe and the stomach.

The *gall-bladder* is a thin-walled sac which lies in a groove of the right central lobe. Its duct, called the *cystic duct*, unites with those from the liver and opens into the duodenum in connection with one of the pancreatic ducts.

3. The numerous **Lymph Glands** are distributed between the layers of the mesentery. Several are found in the angle between the cæcum and the small intestine and are known as the *pancreas Asselli*.

The *anal glands* are two oval bodies imbedded in the tissue beneath the skin on either side of the anus.

The **Spleen** is the long red body lying on the left side, near the stomach. It is suspended in the omentum.

C.—Urinary System.

1. The **Kidneys** are the pair of large dark-red bodies of characteristic shape lying on the dorsal wall of the abdominal cavity. On the side of the kidney toward the mid-line there is a marked con-

cavity or *hilus*. The kidneys lie outside of the peritoneum.

If the kidney be cut horizontally through its long axis it will be found to consist of two layers, the *cortical* and the *medullary*. The outer, cortical portion is of lighter color, the medullary portion is darker and is arranged in a conical mass or pyramid which projects into the cavity or *pelvis* of the kidney.

2. The **Ureter** is the tube which passes backward from the hilus of the kidney to the dorsal wall of the bladder.

3. The **Bladder** is a muscular sac lying near the symphysis pubis. It receives the ureters obliquely in its dorsal surface and opens to the exterior through the *urethra*.

The **Adrenal Bodies** are two small whitish bodies which lie internal to the anterior portion of each kidney. They are imbedded in fat.

D.—Reproductive System.

It will be necessary to cut away the symphysis pubis in order to trace fully the reproductive system.

MALE.

1. The **Testes** are the essential male organs corresponding to the ovaries of the female. They are situated in a pouch, the *scrotal sac*, lying posterior to the symphysis pubis. If the scrotal sac

is removed, the testes will be seen as two oval bodies enveloped in a sheath of peritoneum, the *tunica vaginalis*, within which is a white fibrous membrane of connective tissue, the *tunica albuginea*.

2. The **Epididymis** is a convoluted mass of tubes which lies external to the tunica albuginea. The enlarged portion at the anterior end is the *caput epididymis*; it is connected with the testis by certain ducts. The posterior narrow portion is the *cauda epididymis*, which at the posterior end of the testis is continued as the vas deferens.

3. The **Vas Deferens** is the continuation of the canal of the epididymis; it passes upward from the testis along with the spermatic artery and vein. These together form the *spermatic cord* and are enclosed in a common sheath. The vas deferens passes forward through an oblique opening in the abdominal wall, the *inguinal canal*, bends around the neck of the bladder, and enters the dorsal surface of the urethra to form the *urino-genital canal*.

4. The **Prostate Gland** is the glandular mass surrounding the urethra at the point of entrance of the vasa deferentia.

5. **Cowper's Glands** are the two glands, one on each side of the urino-genital canal, just beyond the prostate.

6. The **Penis** is the conical pointed organ suspended from the wall of the abdomen by a fold of the integument. It is composed of a median ven-

tral mass, the *corpus spongiosum*, and two latero-dorsal masses, the *corpora cavernosa*. It has at its extremity the external orifice of the urino-genital canal. The distal end of the penis is formed by an expansion of the corpus spongiosum, the *glans*, which is covered by a fold of the integument, the *prepuce*. The corpora cavernosa diverge anteriorly, forming the *crura penis*, and are attached to the ischia. In the distal portion of the penis, just over the urino-genital canal, is a small bone, the *os penis*.

FEMALE.

1. The **Ovaries** are a pair of small, pinkish bodies suspended by a fold of peritoneum from the dorsal wall of the abdominal cavity, just posterior to the kidneys.

2. The **Fallopian Tubes** are the two small ducts whose fimbriated ends partially grasp the ovaries.

3. The **Uterus** is formed by the immediate expansion of the Fallopian tubes. It consists of two *horns* which meet in the mid-line to form the *body of the uterus*.

4. The **Vagina** is the posterior continuation of the body of the uterus and opens into the vestibule.

5. The **Vestibule or Urino-genital Canal** is the canal formed by the union of the urethra and vagina.

6. The **Clitoris** is a small papilla lying on the ventral wall of the vestibule. It is homologous with the penis of the male.

THORACIC VISCERA.

Remove the skin from the anterior part of the thorax, and cut away the ribs and sternum.

1. The **Pleuræ** are the membranes which line the two sides of the thorax and are reflected over the lungs and great blood-vessels. They meet in the mid-line and form a double-walled septum, the *mediastinum*. The anterior part contains between its walls the heart and its pericardium. The posterior portion contains the œsophagus and blood-vessels.

2. The **Lungs** are the pinkish lobulated bodies lying on either side in the thoracic cavity. The lungs normally fill the entire thoracic cavity except that part occupied by the heart. When the thorax is opened they are usually found collapsed. The right lung is divided into four lobes and the left into two.

The lungs may be artificially inflated to better demonstrate the lobes.

3. The **Trachea** may be seen, by pushing aside the heart and lungs, as a cartilaginous, annulated tube. This leads from the pharynx to the base of the lungs, where it divides into two *bronchi*, one of which goes to each lung and there subdivides into numerous smaller bronchi which penetrate the various lobes.

4. The **Thymus Gland** is the mass of glandular

tissue which partially invests the trachea just anterior to the heart. It is of large size during immaturity, but atrophies in the adult.

5. The **Heart** is the muscular organ lying in the centre of the thoracic cavity. From the anterior part all of the great blood-vessels of the body arise. The heart is enclosed in a sac of fibrous tissue called the *pericardium*; this is filled with a serous fluid. The heart consists of four chambers, the two anterior called *auricles*, and the two posterior called *ventricles*.

a. The **Right Auricle** occupies the anterior ventral portion of the heart. It consists of a main chamber, the *atrium*, and a lobulated appendage, the *auricular appendix*. The right auricle receives anteriorly the *superior vena cava*, which brings back blood from the anterior part of the body, and at its posterior end the *inferior vena cava*, which returns blood from the posterior part of the body. Between these two openings is the orifice of a small vein which returns blood from the walls of the heart itself, the *coronary vein*. The right auricle opens into the right ventricle by an aperture which is guarded by three membranous flaps, the *tricuspid valve*. These flaps are attached to muscular prolongations of the wall of the ventricle, the *columnæ carneæ*, by tendinous cords, the *chordæ tendinæ*.

b. The **Right Ventricle** forms the right ventral portion of the heart. Its cavity is crescentic, with

much thicker walls than those of the auricle. It receives the blood from the right auricle and pumps it out at its anterior end through the *pulmonary artery*. The opening of this artery is guarded by three flaps, the *semilunar valves*.

c. The **Left Auricle** lies on the anterior dorsal side of the heart. It receives at its dorsal end the *pulmonary veins*, usually two on each side. The left auricle opens into the left ventricle through an aperture guarded by a valve similar to the tricuspid but with only two flaps, the *mitral valve*.

d. The **Left Ventricle** is by far the most muscular portion of the heart. It occupies nearly the whole posterior portion of the organ. Its cavity is oval and receives the blood from the left auricle and forces it out through the *aorta*, whose opening is guarded by semilunar valves similar to those of the pulmonary artery.

The two *coronary arteries* which convey blood to the heart itself lead from the aorta just outside of the semilunar valves.

VISCERA OF THE HEAD AND NECK.

Remove the skin from the head and neck.

A.—Salivary Glands.

1. The **Parotid Gland**, the largest of the salivary glands, lies just beneath the skin at the ventral margin of the cartilage of the ear. Its duct, *Stenson's duct*, may be seen as a fine white canal

passing across the large oval muscle on the side of the jaw. It penetrates the cheek and opens into the mouth opposite the last premolar tooth.

2. The **Submaxillary Gland** lies just below the parotid gland at the angle of the mandible, beneath the large jugular vein. It is smaller than the last and oval in shape. Its duct, *Wharton's duct*, runs forward beneath the facial vein and opens on the floor of the mouth.

3. The **Sublingual Glands**, two on either side, lie anterior to the submaxillary gland and closely connected with it, on each side of the jugular vein. They are smaller than the submaxillary but of the same general appearance.

4. The **Buccal Glands** are a collection of glandular tissue situated at the angle of the mouth.

5. The **Zygomatic Gland** is situated in the orbit beneath the eyeball just inside the anterior end of the zygomatic arch. It will be seen if the roof of the mouth be cut through just posterior to the upper molar tooth.

B.—Mouth, Pharynx, and Larynx.

1. The **Hard Palate** forms the roof of the mouth. It is covered with mucous membrane which is raised into a number of transverse ridges.

2. The **Soft Palate** is the posterior continuation of the hard palate. Its free edge hangs like a transverse curtain across the posterior portion of

the cavity of the mouth, separating the oral and the pharyngeal cavities.

3. The **Tonsils** lie one on either side of the opening leading from the mouth to the pharynx. They are small oval bodies and are partially embedded by lateral prolongations of the soft palate.

4. The **Tongue** is a muscular organ attached posteriorly to the hyoid bone and for the greater part of its length to the floor of the mouth. It is covered with a mucous membrane, which is smooth below but above is provided with three kinds of papillæ. The *circumvallate papillæ* are the rounded prominences situated in two lines converging posteriorly at the back part of the tongue. The *fungiform papillæ* are smaller and more numerous, and are situated on the side and anterior portion of the tongue. The *filiform papillæ*, the most numerous of all, cover the whole of the upper surface of the tongue. They have large, posteriorly-directed, horny points.

5. The **Pharynx** is the large, conical cavity immediately behind and below the soft palate. It is the posterior continuation of the mouth cavity.

6. The **Posterior Nares** are two openings into the pharynx, situated just above the palate. They pass forward into the nasal cavity.

7. The **Eustachian Tubes** are two openings just external to the posterior nares. Their canal places the middle ear in communication with the pharynx.

CHAPTER III

MUSCLES

Remove the skin and dissect away the fat and tissue covering the muscles.

A thin layer of muscular fibres covers the neck, thorax, and abdomen, immediately below the skin. The portion upon the neck is known as the *platysma myoides*. These muscles will be seen as numerous delicate fibres, which remain attached to the skin when it is removed.

MUSCLES OF THE ABDOMEN.

1. The **External Oblique Muscle** is a thin, flat muscle, arising by digitations from the eight posterior ribs and the lumbar fascia. Its fibres run obliquely backward toward the mid-ventral line, and end in a thin, broad aponeurosis, which unites with its fellow of the opposite side. A mid-ventral white line, the *linea alba*, indicates the union of the aponeuroses of the muscles of the two sides. The posterior fibres of the muscle are inserted along the brim of the pelvis. A band of delicate fascia, *Poupart's ligament*, extends from the symphysis pubis to the anterior part of the ventral margin of the ilium. Between Poupart's ligament and the

tendon of the external oblique muscle is an aperture, the *inguinal canal*, through which, in the male, passes the spermatic cord. (Plates II. and IV.)

2. The **Internal Oblique Muscle** lies immediately under the external oblique, from which it must be separated. It is also a thin, muscular sheet, arising from the lumbar fascia, the ventral margin of the ilium, and the pubis. The fibres run obliquely forward toward the mid-ventral line, where they unite with those of the opposite side in a thin aponeurosis. The more anterior fibres are inserted on the cartilages of the ribs. (Plate III.)

3. The **Rectus Abdominis Muscle** is a long, narrow muscle, arising from the symphysis pubis. It runs forward, with its fellow of the opposite side, to its insertion on the first, second, and third ribs. The fibres of the rectus abdominis are intercepted at intervals by transverse tendons, making it a true "polygastric muscle." Posteriorly the rectus abdominis muscle lies dorsal to the aponeuroses of the external and internal oblique muscles, but anteriorly it lies between the aponeuroses of these muscles. (Plates III. and IV.)

4. The **Transversalis Abdominis Muscle**, the most internal of the abdominal muscles, is a very thin, muscular sheet. It arises from the cartilages of the posterior ribs, the lumbar fascia, and the ventral margin of the ilium. Its fibres run transversely and end in an aponeurosis beneath the rectus abdominis. (Plate IV.)

5. The **Diaphragm** is the musculo-tendinous partition separating the abdominal and thoracic cavities. The muscular portion of the diaphragm at its circumference arises ventrally from the ensiform cartilage, laterally from the last five ribs and the aponeuroses of the muscles of the back, and dorsally from the bodies of the lumbar vertebræ by two thick slips or *crura*. From all these points the fibres converge, to end in the *central tendon*. The diaphragm is pierced by the œsophagus, aorta, and inferior vena cava.

MUSCLES OF THE THORAX.

1. The **Pectoralis Muscle** is a very large triangular muscle, having its origin on the sternum and the cartilages of the ribs and its insertion on the humerus. It is made up of the following five portions :

a. A long, narrow, superficial division which arises beneath the manubrium and the cartilages of the first two ribs. Part of this is inserted in the fascia of the fore-leg, and part of it joins one of the shoulder muscles, the *cephalo-humeral*. (Plates III. and IV.)

b. The largest division arises from the manubrium and anterior third of the sternum, and is inserted on the outer side of the deltoid ridge of the humerus. (Plate IV.)

c. Another division arises from the sternum, between the cartilages of the second and sixth ribs.

It is inserted into the head of the humerus. (Plate IV.)

d. The posterior division takes its origin from the sternum, between the cartilages of the fifth and eighth ribs, and is inserted principally on the inner side of the deltoid ridge of the humerus. (Plate IV.)

e. The smallest and most anterior part arises from the side of the manubrium and is inserted on the humerus just above the insertion of *b*, from which it can be separated with difficulty. This division also sends some fibres to the clavicle.

To expose the remaining muscles of the thorax the pectoralis group must be reflected.

2. The **Sternalis Muscle** is a small triangular muscle arising from the fascia of the rectus abdominis, at the point where the cartilages of the third and fourth ribs unite with the sternum. Its fibres pass forward and outward and are inserted on the first rib. A second, smaller, sternalis muscle lies just outside the rectus abdominis, at the level of the sixth rib. (Plates III. and IV.)

3. The **Scalenus Primus Muscle** is long and narrow. It takes its origin from the fourth and fifth cervical vertebræ, and is inserted on the cartilages of the fourth, fifth, and sixth ribs. (Plates III. and IV.)

4. The **Scalenus Secundus Muscle** lies deeper than the last. It takes its origin from the transverse

processes of the third, fourth, fifth, sixth, and seventh cervical vertebræ, and is inserted on the first rib. (Plates III. and IV.)

5. The **External Intercostal Muscles** are the outer muscular layers extending between the bony ribs. Their fibres run backward and downward. (Plates III. and IV.)

6. The **Internal Intercostals** are muscular sheets lying under the former, their fibres running backward and upward. They are covered by the external intercostals, except between the cartilaginous ribs. (Plate III.)

7. The **Serratus Posticus Muscle** arises from the fascia of the mid-dorsal line, and is inserted by digitations on the eighth, ninth, tenth, eleventh, and twelfth ribs. A dense membrane, the *vertebral aponeurosis*, is continuous with the muscle anteriorly. This membrane passes forward between the muscles of the back and those of the shoulder, and covers over the *erector spinæ muscles*, which fill the groove on either side of the neural processes of the vertebræ. (Plate III.)

MUSCLES OF THE FORE-LEG AND SHOULDER.

1. The **Cephalo-humeral or Anterior Trapezius Muscle** takes its origin from the back of the skull and the mid-dorsal line of the neck. It is very long and passes downward, covering the anterior part of the fore-leg, to its insertion on the coronoid proc-

ess of the ulna. The clavicle is attached to the under side of this muscle, in front of the shoulder-joint. Just before the cephalo-humeral is inserted on the ulna, it receives fibres from the first division of the pectoralis. (Plates II. and IV.)

2. The **Middle Trapezius Muscle** arises along the mid-dorsal line, immediately posterior to the origin of the cephalo-humeral. Its fibres converge to their insertion upon the spine of the scapula. (Plate II.)

3. The **Posterior Trapezius Muscle** arises a little posterior to the origin of the middle trapezius, along the mid-dorsal line, above the neural processes of the thoracic vertebræ. It is inserted on the spine of the scapula, above the insertion of the middle trapezius. (Plate II.)

4. The **Latissimus Dorsi** is the very broad muscle covering a great part of the dorsal portion of the abdomen and thorax. It takes its origin from the neural processes of the last nine dorsal vertebræ, and by fascia from the neural processes of the lumbar vertebræ. Its fibres converge anteriorly, and, blending with the adjacent fibres of the posterior division of the pectoralis muscle, are inserted, together with another muscle, the teres major, by a flat tendon, on the inner side of the shaft of the humerus. The insertion is just below the lesser tuberosity. (Plates II. and IV.)

5. The **Cleido-mastoid** is a narrow strip of muscle arising from the clavicle and extending to the mastoid process. (Plates II. and IV.)

Reflect the cephalo-humeral and the middle and posterior trapezius muscles.

6. The **Rhomboideus Major** is the broad muscle which arises from the neural processes of the six posterior cervical and the anterior dorsal vertebræ. It is inserted on the vertebral margin of the scapula. (Plate III.)

7. The **Rhomboideus Capitis** is a narrow muscular band lying along the anterior margin of the rhomboideus major. Its origin is on the lambdoidal ridge of the skull and its insertion is on the vertebral margin of the scapula, just in front of the insertion of the rhomboideus major. (Plate III.)

8. The **Levator Claviculæ** is a long, narrow muscle which arises from the transverse process of the atlas, and is inserted on the metacromion process of the scapula. (Plate II.)

9. The **Spino-deltoid Muscle** takes its origin from the spine of the scapula, opposite the insertion of the middle trapezius muscle. Its fibres run down to unite with those of the following muscle. Both are inserted on the deltoid ridge of the humerus. (Plates II. and III.)

10. The **Acromio-deltoid Muscle** is similar in shape to the spino-deltoid muscle. It arises from both the acromion and metacromion processes, and also from the intervening portion of the spine of the scapula. It is inserted, together with the spino-

deltoid muscle, on the deltoid ridge of the humerus. (Plates II. and III.)

11. The **Epitrochlear** is a small muscle, varying in shape, size, and position. It arises partly from the fascia of the scapula, just below the insertion of the posterior trapezius, and partly by muscular fibres from a subjacent muscle, the latissimus dorsi. It is inserted by fascia on the inner side of the olecranon process of the ulna. (Plate II.)

Reflect the deltoid and levator claviculæ muscles.

12. The **Supraspinatus** is the large, thick muscle which fills the entire supraspinous fossa of the scapula and projects considerably over its anterior border. Its fibres originate from the entire fossa, the anterior side of the spine of the scapula, and the acromion process. They are inserted by a strong tendon into the great tuberosity of the humerus. (Plates III. and IV.)

13. The **Infraspinatus Muscle** occupies the infraspinous fossa of the scapula. Its fibres arise from the whole fossa, the posterior side of the spine of the scapula, and the acromion and metacromion processes. They converge into a strong tendon, which is inserted on the outer side of the great tuberosity of the humerus, beside the insertion of the supraspinatus muscle. (Plate III.)

14. The **Teres Major** is a thick muscle lying along the posterior margin of the scapula. It has its origin on the upper third of the axillary border

of the scapula, and is inserted, together with the latissimus dorsi, by a flat tendon, on the humerus, just below the lesser tuberosity. (Plates III. and IV.)

15. The **Teres Minor** is a much smaller muscle which arises from the lower half of the axillary margin of the scapula, and is inserted on the great tuberosity of the humerus, just below the insertion of the infraspinatus muscle. (Plate III.)

Reflect the latissimus dorsi, rhomboideus major, and rhomboideus capitis muscles.

16. The **Levator Anguli Scapulæ** is the thick muscle which takes its origin from the transverse processes of the last five cervical vertebræ, and is inserted on the anterior half of the vertebral margin of the scapula. (Plates III. and IV.)

17. The **Serratus Magnus** is the large muscle continuous with the posterior margin of the levator anguli scapulæ. It arises by digitations from the first nine or ten ribs, and is inserted on the posterior half of the vertebral margin of the scapula. The serratus magnus and levator anguli scapulæ form a single sheet of muscle, which suspends the body from the fore-limbs. (Plates III. and IV.)

18. The **Subscapularis** is the muscle which fills the entire subscapular fossa. It takes its origin from the greater part of the fossa, from which its fibres converge to their insertion, by tendon, on

the lesser tuberosity and capsular ligament of the head of the humerus. (Plate IV.)

19. The **Coraco-brachialis** is a small muscle lying on the inner side of the shoulder-joint and covering the insertion of the subscapularis muscle. It is composed of two parts, both of which arise from the coracoid process of the scapula and are inserted on the inner side of the humerus, just above the insertion of the teres major. (Plate IV.)

20. The **Biceps** is a long, spindle-shaped muscle, lying on the flexor (anterior) surface of the humerus. It arises by a strong tendon from the anterior margin of the glenoid cavity of the scapula, and is inserted by a similar tendon on the tubercle of the radius. (Plates III. and IV.)

21. The **Brachialis Anticus Muscle** lies closely along the outer side of the anterior surface of the humerus, below the insertion of the teres minor. Its fibres converge to their insertion on and near the coronoid process of the ulna. (Plates II. and III.)

22. The **Triceps** is the large mass of muscle on the extensor (posterior) surface of the humerus. It consists of five parts, as follows :

a. The largest division of the triceps arises by a broad tendon from the lower half of the axillary border of the scapula, between the subscapularis and teres minor muscles. It is inserted by a strong tendon on the olecranon process of the ulna. (Plates II., III., and IV.)

b. The second and most external part arises from the head of the humerus, beneath the insertion of the *teres minor*. Its fibres pass downward, and are inserted by a tendon on the olecranon process. (Plates II. and III.)

c. The third division arises from the upper part of the shaft of the humerus, below the insertion of the *teres major*. Its fibres unite with those of the fourth division (*d*), and are inserted on the olecranon process. (Plates III. and IV.)

d. This division is the most internal, and arises just below the head of the humerus, between the origin of the second division (*b*) and the insertion of the *coraco-brachialis*. It passes downward and unites with the third part (*c*), and both are inserted on the olecranon process. (Plate IV.)

e. The smallest part of the *triceps* arises from the bridge of bone bounding the supracondyloid foramen of the humerus, as far down as the internal condyle. Its fibres pass back to their insertion on the inner side of the olecranon process.

23. The **Anconeus Muscle** arises from the lower half of the shaft of the humerus, the margins of the olecranon fossa, and the external condyle. Its fibres pass between the second (*b*) and third (*c*) parts of the *triceps*, to their insertion in the fossa just outside the olecranon process. (Plates II. and III.)

MUSCLES OF THE HIND-LEG.

1. The **Sartorius** is a broad, thin muscle which covers the anterior and internal parts of the thigh. It arises from the anterior ventral margin of the ilium, and is inserted both on the ligament of the patella and the internal tuberosity of the tibia. (Plates II., III., and IV.)

2. The **Tensor Vaginæ Femoris** is a large muscle which arises from the anterior end of the ilium and the adjacent fascia. It is inserted by a strong fascia, which dips in between the muscles, and extends down to the external condyle of the femur. (Plates II. and IV.)

3. The **Biceps Femoris** is a very large muscle, covering the greater part of the external surface of the thigh. It arises from the tuberosity of the ischium, and is inserted by a strong fascia on the outer side of the tibia, for the greater part of its length. (Plate II.)

4. The **Gluteus Maximus** is the muscle lying between the biceps femoris and the tensor vaginæ femoris. It arises partly from the sacrum and the fascia covering it dorsally, and partly from the first two caudal vertebræ, and is inserted on the great trochanter and shaft of the femur by a sheet of fascia. (Plate II.)

5. The **Tenuissimus** is a long and very slender muscle which arises from the caudal vertebræ, below the origin of the gluteus maximus. It runs

along the inner side of the biceps femoris, with which muscle it finally fuses. (Plate III.)

Reflect the preceding muscles.

6. The **Gluteus Medius** is a thick muscle lying directly under the gluteus maximus. It arises from the outer surface of the ilium and the fascia, between the gluteus maximus and tensor vaginæ femoris, and is inserted on the great trochanter of the femur. (Plate III.)

7. The **Gluteus Minimus** lies directly under the gluteus medius. Its origin is on the ilium, just posterior to the origin of the preceding muscle, and also on the anterior part of the ischium. It is inserted on the great trochanter. (Plate III.)

8. The **Quadratus Femoris** is the small quadrangular muscle arising from the tuberosity of the ischium. It is inserted on the posterior surface of the femur, near the great trochanter. (Plate III.)

9. The **Semitendinosus** is the smaller and more external of the two posterior muscles of the thigh. It arises from the tuberosity of the ischium, and is inserted by fascia on the inner side of the tibia, and by tendon on the front of the tibia, just below the patella. (Plates II., III., and IV.)

10. The **Semimembranosus** is the larger of the two posterior muscles of the thigh. Its origin is on the ischium, from the tuberosity to the symphysis pubis. It is inserted (1) on and above the inner condyle of the femur, and (2) by a strong

tendon on the internal tuberosity of the tibia. (Plates II., III., and IV.)

11. The **Quadriceps Extensor** is composed of four large muscles which have separate origins but are inserted on the tuberosity of the tibia by a common tendon, the "tendon of the patella."

a. The *vastus externus* is the largest and most external of the four divisions. Its origin is on the whole outer surface of the shaft of the femur and on the great trochanter. (Plate III.)

b. The *rectus femoris* is the most anterior of the four divisions, lying between the vastus externus and the muscle next to be described, the vastus internus. It arises from the ilium just above the acetabulum. (Plate IV.)

c. The *vastus internus* lies between the rectus femoris and the sartorius. It arises from the inner and anterior side of the upper part of the femur. (Plate IV.)

d. The *vastus medius*, the smallest division, arises from the lower part of the front of the femur. To expose this muscle the three preceding divisions must be reflected.

12. The **Pyriformis** is a small triangular muscle. It arises from the ventral surface of the sacrum, and, passing along the posterior margin of the gluteus minimus, is inserted on the great trochanter of the femur.

13. The **Gracilis** is a broad, thin muscle, covering the greater part of the inner side of the thigh.

It arises below the symphysis pubis, and is inserted by fascia on the inner side of the tibia, partially beneath the insertion of the sartorius. (Plate IV.)

Reflect the gracilis muscle.

14. The **Adductor** is a large muscle arising from the pubis and ischium, near the symphysis, and below the origin of the gracilis. It is inserted on the posterior part of the femur, along the linea aspera. (Plates III. and IV.)

15. The **Pectineus** is a small, thin muscle, arising from the pubis, near the symphysis. It is inserted on the ridge between the lesser trochanter and the linea aspera of the femur, and also on the linea aspera itself. (Plate IV.)

16. The **Psoas Magnus** is the large, cylindrical muscle lying along the dorsal wall of the abdominal cavity. It arises from the transverse processes of the lumbar vertebræ, and passes out beneath the brim of the pelvis. It is inserted on the lesser trochanter of the femur. (Plate IV.)

MUSCLES OF THE NECK.

1. The **Sterno-mastoid Muscle** is a long, narrow band which arises from the side of the manubrium, below the anterior part of the pectoralis major, and is inserted on the skull just above the mastoid process. (Plates II., III., and IV.)

Reflect the sterno-mastoid muscle.

2. The **Sterno-hyoid** is a similar muscle, lying beneath the sterno-mastoid, and covering the trachea along the mid-ventral line. It arises on the anterior end of the manubrium, and is inserted on the basi-hyal bone. (Plate IV.)

Reflect the sterno-hyoid muscle.

3. The **Sterno-thyroid** is a slender muscle which arises from the anterior end of the manubrium, below the origin of the sterno-hyoid. It is inserted on the thyroid cartilage of the larynx. (Plate IV.)

4. The **Digastric** is a relatively large muscle, situated at the angle of the mandible. It arises from the skull, posterior to the external auditory meatus, and is inserted along the inner surface of the anterior half of the mandible. (Plates II., III., and IV.)

5. The **Genio-hyoid** is a small, thin muscle, lying along the mid-line of the under side of the mandible. It arises near the symphysis, and is inserted on the basi-hyal bone. (Plate IV.)

6. The **Mylo-hyoid** is the flat muscle forming the floor of the mouth. It arises on the inside of the mandible, and is inserted on the basi-hyal bone. (Plate IV.)

7. The **Thyro-hyoid Muscle** arises from the thyroid cartilage of the larynx, and is inserted on the

thyro-hyal bone. It appears to be a continuation of the sterno-thyroid muscle.

8. The **Splenius** is a large muscle which takes its origin on the mid-dorsal line of the neck and from the neural processes of the anterior dorsal vertebræ. It is inserted on the outer part of the lambdoidal ridge of the skull. (Plate III.)

The **Masseter** is the thick, oval muscle lying just back of the eye. It arises from the malar bone and from the zygomatic process of the temporal bone, and is inserted on the outer surface of the ascending ramus of the mandible. (Plates II., III., and IV.)

The **Temporalis** is the fan-shaped muscle covering the side of the skull. It arises from the skull between the lambdoidal ridge and the post-orbital process of the frontal bone. Its fibres converge, filling up the temporal fossa, and are inserted on the coronoid process of the mandible. (Plates II. and III.)

CHAPTER IV

VASCULAR SYSTEM

ARTERIAL SYSTEM. (Plate V.)

The **Aorta** is the large blood-vessel which leaves the left ventricle of the heart and bends in an arch to the left and passes posteriorly along the mid-line. It gives off the following branches :

1. The **Brachio-cephalic** or **Innominate Artery** is the first and larger of the two branches which lead anteriorly from the arch of the aorta. It soon gives off the following :

a. The **Right and Left Carotid Arteries**. These pass anteriorly along either side of the trachea and are distributed to the neck and head. Their principal branches are :

(1) The **Thyroid Artery**, given off at the level of the thyroid gland, and distributed principally to that organ.

(2) A large **Muscular Branch**, given off directly opposite the thyroid artery, which supplies the muscles of the neck.

(3) The **Lingual Artery**, which is distributed to the under surface of the tongue.

(4) The **Facial Artery**, which sends branches to

the cheek, lips, muscles of the mandible, and to the submaxillary gland.

(5) The **Post-auricular Artery**, which is distributed to the posterior side of the ear.

(6) The **Temporal Artery**, which is distributed to the parotid gland and muscles of the side of the head.

After giving off the temporal branch, the carotid passes beneath the masseter muscle and ends in a plexus of small blood-vessels near the glenoid fossa.

6. The **Right Subclavian Artery**. After giving off the two carotid arteries, the remaining portion of the brachio-cephalic is known as the right subclavian artery. It gives off the following branches :

(1) The **Vertebral Artery**, which pierces the transverse processes of the six anterior cervical vertebræ, enters the foramen magnum, and unites with its fellow of the opposite side to form the *basilar artery* of the brain.

(2) The **Superior Intercostal Artery**, arising a little beyond the vertebral artery, is distributed to the intercostal muscles between the four anterior ribs.

(3) The **Sternal or Internal Mammary Artery**, given off just beyond the last, runs posteriorly along the inner surface of the sternum.

(4) The **Thyroid Axis** arises directly opposite the sternal artery, and passes anteriorly and dorsally. It supplies the suprascapular region, and gives off a branch to the thyroid gland.

(5) The **Superior Thoracic Artery**, arising a short distance from the thyroid axis, supplies the pectoral muscle.

(6) The **Long Thoracic Artery**, arising a little beyond the superior thoracic artery, supplies the thoracic muscles.

(7) The **Subscapular and Posterior Circumflex Arteries** arise from a common trunk, which is given off from the subclavian a little beyond the long thoracic. The subscapular artery supplies the muscles of the subscapular region. The posterior circumflex passes between the subscapular and teres major muscles, and supplies the muscles of the arm.

(8) The **Anterior Circumflex Artery**, which runs obliquely around the humerus and supplies certain muscles of the arm.

The portion of the subclavian artery between the thyroid axis and circumflex artery is known as the *axillary artery*. After reaching the arm it becomes the *brachial artery*.

(9) The **Superior and Inferior Profunda Arteries**, given off from the brachial, between the shoulder and elbow.

(10) The **Ulnar and Radial Arteries**, the two branches into which the brachial divides at the elbow. The radial artery is a direct continuation of the brachial artery, and passes along the flexor surface of the limb to the wrist, where it turns to the dorsal surface, and forms, with a branch of the

ulnar artery, the *palmar arch*. The ulnar artery is smaller and less superficial than the radial.

2. The **Left Subclavian Artery**, unlike the right subclavian, which arises as a branch of the brachiocephalic artery, takes its origin directly from the arch of the aorta. Its branches are similar to those of the right subclavian artery.

3. The **Intercostal Arteries** arise in ten pairs from the thoracic portion of the aorta and supply all but the first three intercostal spaces.

4. The **Bronchial Arteries** arise from the aorta near the fourth intercostal artery and supply the lungs.

4.5 *Esophageal*
5. The **Phrenic Artery** is a small branch given off from the aorta as it pierces the diaphragm, which organ it supplies.

6. The **Celiac Axis** is a large branch given off from the aorta after it pierces the diaphragm. It divides into three branches :

a. The **Hepatic Artery**, which sends branches to the liver, duodenum, and pancreas.

Gastric
b. The **Coronary Artery**, which is distributed along the small curvature of the stomach.

c. The **Splenic Artery**, which supplies the spleen and portions of the stomach.

7. The **Superior Mesenteric Artery** arises next posterior to the celiac axis. It subdivides in the mesentery and conveys blood to the intestine.

8. The **Suprarenal Arteries** are two small branches which arise near the superior mesenteric artery and supply the adrenal bodies.

9. The **Renal Arteries** are two large arteries which arise one on either side and supply the kidneys.

10. The **Spermatic Arteries**, in the male, are two long, slender arteries which arise a little posterior to the renal arteries. They pass backward through the inguinal canal as part of the spermatic cord and supply the testes.

In the female the **Ovarian Arteries** arise in nearly the same place and supply the ovaries.

11. The **Inferior Mesenteric Artery** arises some distance posterior to the last, and is distributed to the lower part of the large intestine and rectum.

12. The **Ilio-lumbar Arteries** are two arteries which arise on either side of the aorta, and supply the muscles of the back.

13. The **External Iliac Arteries** are two large arteries given off in the posterior part of the abdominal cavity. They run outward and downward to each hind limb. Before passing Poupart's ligament each gives off a large branch, the *obturator artery*, which passes through the obturator foramen to the muscles on the back of the pelvis. The obturator artery has a branch, the *epigastric artery*, which passes forward along the abdominal wall and anastomoses with the internal mammary artery. Each external iliac artery passes beneath Poupart's ligament to reach the thigh, where it becomes the *femoral artery*. Near its origin each gives off the *deep femoral* or *profunda artery* to the muscles of the thigh. At the knee-joint the

femoral is called the *popliteal artery*, and, continuing, divides into the *anterior* and *posterior tibial arteries*. The posterior tibial artery runs down behind the tibia to the inner side of the os calcis, where it divides into the *internal* and *external plantar arteries*. The anterior tibial artery passes along the anterior part of the leg, and becomes the *dorsal artery of the foot*.

14. The **Internal Iliac Arteries** are two large lateral branches into which the aorta divides soon after giving off the external iliacs. Each internal iliac gives off a small artery to the bladder, the *superior vesical*, and then divides into two branches, the *pudic* and *sciatic arteries*. The pudic divides into the *internal pudic*, which is distributed within the pelvis to the genital organs, and the *external pudic*, which supplies the external genital organs. The sciatic, after giving off the *gluteal*, which is distributed to the muscles on the back of the pelvis, passes out through the great sciatic notch, and goes to the muscles of the hip and thigh.

15. The **Caudal Artery** is the posterior continuation of the aorta. It passes along beneath the tail.

Muscular Branches are given off at various points, both from the aorta and from other arteries to adjacent muscles.

VENOUS SYSTEM. (Plate VI.)

A.—Præ-cava.

The **Præ-cava**, or **Superior Vena Cava**, is the large vein which brings back blood from the anterior part of the body, and empties into the right auricle, as already described. It receives the following branches :

1. The **Azygos Vein** collects the blood from the intercostal and lumbar regions, and empties into the præ-cava in front of the heart.

2. The **Vertebral Vein** of the right side joins the superior vena cava some distance anterior to the azygos vein.

3. The **Sternal Veins** enter the præ-cava by a common trunk on its ventral side just anterior to the right vertebral vein. They arise as two veins on either side of the sternum, and, passing anteriorly, unite at the level of the fourth rib.

4. The **Brachio-cephalic** or **Innominate Veins** are two large veins which unite at the level of the subclavian arteries to form the præ-cava.

5. The **External Jugular Vein** is formed by the union of the *temporal*, *internal maxillary*, and *facial veins*, which correspond to the arteries of the same names. It runs just beneath the skin, across the sterno-mastoid muscle, and empties into the subclavian vein. Between the temporal and

facial veins the two external jugular veins are united by a cross branch, the *transverse vein*.

6. The **Internal Jugular Vein** returns blood from the brain. It runs parallel to the carotid artery, internal to the external jugular vein and unites with the external jugular vein just before it empties into the brachio-cephalic.

7. The **Subclavian Vein** is the large vessel which returns blood from the fore-leg, where it has branches similar to those of the subclavian artery. It unites with the external jugular vein to form the brachio-cephalic vein.

8. The **Left Vertebral Vein** returns blood from the cranial cavity. It empties into the left brachio-cephalic, between the entrance of the external jugular and the union of the brachio-cephalic veins.

B.—Post-cava.

The **Post-cava** or **Inferior Vena Cava** is the large vein which returns blood from the posterior part of the body, and empties into the right auricle. It receives its first branch as it pierces the diaphragm.

1. The **Phrenic Veins** collect blood from the diaphragm, and enter the post-cava just as it pierces that organ.

2. The **Hepatic Veins** collect the blood from the liver, and empty into the post-cava, near the phrenic veins.

3. The **Suprarenal Veins** collect the blood from the abdominal walls and adrenal bodies, and usually empty into the post-cava, near the level of the corresponding arteries.

4. The **Renal Veins** correspond to the arteries of the same name.

5. The **Spermatic** and **Ovarian Veins** correspond to the spermatic and ovarian arteries, though usually those of the left side empty into the renal vein instead of the post-cava.

6. The **Ilio-lumbar Veins** also correspond to the ilio-lumbar arteries.

7. The **Common Iliac Veins** are two large veins which unite with the caudal vein to form the post-cava. They are formed by the union of the *internal* and *external iliac veins*, which have a similar distribution to the arteries of the same name.

8. The **Caudal Vein** is the direct continuation of the post-cava. It returns blood from the tail.

C.—Portal System.

The **Portal Vein** is formed by a number of branches, which collect the blood from the intestines, spleen, pancreas, and stomach. These branches unite within the mesentery. The portal vein enters the under side of the liver, just above the hepatic artery. In the liver it breaks up into capillaries, which again unite, to form the hepatic vein. This vein empties into the post-cava, near the diaphragm, as already described.

The portal system returns blood from the regions supplied by the superior and inferior mesenteric arteries and the coeliac axis.

CHAPTER V

NERVOUS SYSTEM

INVESTING MEMBRANES.

1. The most external of the three membranes which enclose the brain and spinal cord is the *dura mater*. It is a thick, fibrous membrane, which lines the inside of the skull and vertebral column. It dips down in a longitudinal fold between the two lobes of the brain forming the *falx cerebri*. It also makes a transverse fold below the posterior margin of the parietal bone, between the cerebrum and cerebellum. This is called the *tentorium*, and in adult cats becomes ossified.

2. The most internal membrane, the *pia mater*, is much thinner and less dense, and closely invests the brain and cord. The blood-vessels supplying the central nervous system are contained in this membrane.

3. The *arachnoid* is a very delicate membrane, lying between the *dura* and *pia mater*. It is closely connected with the *dura mater*, but does not follow all the folds of the *pia mater*. It may be seen bridging over the fissures of the brain.

EXTERNAL ANATOMY OF THE BRAIN.

The brain is the portion of the nervous system within the cranial cavity. It is divided into three principal parts—the cerebrum, cerebellum, and medulla oblongata.

The *cerebrum* forms the largest part of the brain, occupying the anterior portion of the cranial cavity. It consists of two lobes or hemispheres.

The *cerebellum* is the unpaired posterior portion of the brain. It is connected with the rest of the brain by bands of fibres or *crura*, two of which pass to the cerebrum, two to the medulla, and two blend together below the cerebrum and form the *pons Varolii*.

The *medulla oblongata* forms the posterior part of the brain, below the cerebellum. It is continuous posteriorly with the spinal cord.

A.—Cerebrum.

1. The **Cerebrum** is the large anterior part of the brain. It consists of two lobes or hemispheres, which are composed of a number of convolutions, or *gyri*, separated by fissures, or *sulci*. (Plate VII., A, B, and C.)

2. The **Olfactory Lobes** are the two small, knob-like prolongations from the anterior ventral surface of the cerebral hemispheres. (Plate VII., A and C.)

3. The **first** pair of cranial nerves, the **Olfactory**, arise from the under side of the olfactory lobes.

4. The **Corpus Callosum** is the broad white band of fibres connecting the two cerebral hemispheres. It may be seen from the dorsal side by pressing the hemispheres apart. (Plate VII., c.)

5. The **Corpora Quadrigemina** are the two pairs of rounded elevations which lie on the dorsal surface of the brain, between the cerebrum and cerebellum, which must be pressed apart to expose them. The anterior pair are smaller than the posterior, and are called the *nates*. The posterior pair are called the *testes*. (Plate VII., c.)

6. The **Pineal Gland** is a single rounded prominence, lying in the mid-dorsal line, just anterior to the nates. (Plate VII., c.)

7. The **Valve of Vieussens** is the delicate membrane covering the cavity of the brain, posterior to the corpora quadrigemina and beneath the anterior portion of the cerebellum. (Plate VII., c.)

8. The **second** pair of cranial nerves, the **Optic**, are the large nerves arising from the transverse band of fibres known as the optic chiasma, situated on the ventral side of the brain, just posterior to the fissure separating the two hemispheres. (Plate VII., A and c.)

9. The **Optic Chiasma** is formed by the crossing of the fibres of the optic tracts which run up beneath the cerebral lobes and over the ventral surface of two oval bodies, the optic thalami, to which they send fibres, and end finally in the corpora quadrigemina. (Plate VII., A and c.)

10. The **Lamina Cinerea** lies just anterior to the optic chiasma. It is a thin membrane, connecting the optic chiasma and corpus callosum, and enclosing a cavity in the brain known as the third ventricle. (Plate VII., c.)

11. The **Pituitary Body** is situated at the end of a conical prolongation of the ventral surface of the brain just posterior to the chiasma. In most cases it is torn off in removing the brain from the skull, leaving nothing but a hollow stalk. (Plate VII., A and c.)

12. The **Infundibulum** is the hollow conical projection which forms the stalk of the pituitary body. The cavity of the infundibulum is continuous with the third ventricle. (Plate VII., c.)

13. The **Tuber Cinereum** is a slight prominence, from which projects the infundibulum. (Plate VII., A.)

14. The **Corpora Albicantia** are two small, rounded elevations, just posterior to the tuber cinereum. (Plate VII., A.)

15. The **Crura Cerebri** are two thick bands of fibres which diverge on either side of the corpora albicantia, and pass dorsal to the optic tracts. (Plate VII., A.)

16. The **third** pair of cranial nerves, the **Oculomotor**, emerge in the mid-ventral line, posterior to the corpora albicantia, in the angle between the diverging crura cerebri. (Plate VII., A.)

17. The **fourth** pair of cranial nerves, the **Pathetic**,

emerge from the surface of the brain on the outer sides of the crura cerebri.

B.—Cerebellum.

1. The **Cerebellum** is the large unpaired portion of the brain lying just posterior to the cerebral hemispheres. The dorsal surface is marked by numerous parallel grooves. It consists of two lateral lobes or *hemispheres*, and a median portion or *vermis*. It is connected with the rest of the brain by three pairs of fibrous bands or crura. The first pair are the *superior peduncles*. They connect the cerebellum with the corpora quadrigemina. The second and largest pair form the lateral continuations of the pons Varolii. They are known as the *middle peduncles*. The third pair, the *inferior peduncles*, connect the cerebellum with the medulla oblongata. (Plate VII., A and C.)

2. The **Pons Varolii** is the broad, transverse band of fibres on the ventral side of the brain, connecting the two sides of the cerebellum. (Plate VII., A.)

3. The **fifth** pair of cranial nerves, the **Trigeminal**, arise by two roots on either side of the pons Varolii. (Plate VII., A.)

4. The **sixth** pair of cranial nerves, the **Abducens**, leave the surface of the brain at the posterior margin of the pons near the mid-ventral line. (Plate VII., A.)

5. The **Anterior Pyramids** are the two longitudinal

bands of fibres, lying on either side of the mid-ventral line, just posterior to the pons. They are a direct continuation of the fibres of the medulla. (Plate VII., A.)

6. The **Corpus Trapezoides** is a transverse band of fibres, posterior to the pons Varolii, covered, in the mid-line, by the anterior pyramids. (Plate VII., A.)

7. The **Olivary Body** is the oval elevation just posterior to the corpus trapezoides and lateral to the anterior pyramids. (Plate VII., A.)

8. The **seventh** pair of cranial nerves, the **Facial**, leave the surface of the brain at the outer anterior angles of the corpus trapezoides. (Plate VII., A.)

9. The **eighth** pair of cranial nerves, the **Auditory**, emerge from the brain at the outer borders of the corpus trapezoides, just posterior to the origin of the seventh. (Plate VII., A.)

C.—**Medulla Oblongata.**

1. The **Medulla Oblongata** is the part of the brain lying posterior to, and below, the cerebellum. It is the expanded anterior portion of the spinal cord, and is composed of a dorsal, a lateral, and a ventral pair of fibrous bundles. (Plate VII., A and C.)

2. The **Posterior Pyramids** are the two dorsal bundles of fibres, lying one on either side of the median fissure. Anteriorly they blend with the restiform bodies.

3. The **Restiform Bodies** are the slightly enlarged portions of the medulla which form the connection between the posterior pyramids and the inferior peduncles of the cerebellum.

4. The **ninth** pair of cranial nerves, the **Glossopharyngeal**, leave the ventral side of the medulla by several roots. (Plate VII., A.)

5. The **tenth** pair of cranial nerves, the **Vagus**, or **Pneumogastric**, arise just posterior to the ninth, by several roots. (Plate VII., A.)

6. The **eleventh** pair of cranial nerves, the **Spinal Accessory**, arise by a series of roots from the sides of the spinal cord and medulla oblongata. They run anteriorly and enter the cavity of the skull. (Plate VII., A.)

7. The **twelfth** pair of cranial nerves, the **Hypoglossal**, arise by several roots from the ventral surface of the medulla, between the anterior pyramids and the olivary bodies. (Plate VII., A.)

INTERNAL ANATOMY OF THE BRAIN.

Slice off the upper part of the right hemisphere to a level with the corpus callosum.

1. The **Gray Matter** will be seen as a narrow, convoluted, cortical layer, surrounding the inner or medullary portion, the **White Matter**. (Plate VII., B.)

2. The **Corpus Callosum** can now be more clearly seen and its fibres traced into the cerebral lobes.

Carefully remove the corpus callosum and expose the cavity below.

3. The **Lateral Ventricles** are the two irregular-shaped cavities, extending below the corpus callosum, through the greater part of each hemisphere. The anterior portion of the ventricle, which is continued forward and downward into the anterior part of the hemisphere, is the *anterior cornu*. The continuation of the ventricle backward and downward forms the *descending cornu*, while the reduced posterior part is the *posterior cornu*. (Plate VII., B.)

4. The **Septum Lucidum** is the partition separating the anterior cornua of the two lateral ventricles.

5. The **Corpus Striatum** is the more or less oval mass, projecting into the cavity of the anterior cornu from its outer wall. (Plate VII., B.)

6. The **Hippocampus Major** is the large oval projection forming the floor of the posterior part of the lateral ventricle and descending cornu. Over its surface passes a thin vascular layer, the *choroid plexus*. (Plate VII., B.)

7. The **Fornix** is formed by two bands of fibres (*the anterior pillars of the fornix*), which pass dorsally from the corpora albicantia, and unite just under the anterior end of the corpus callosum. The triangular sheet formed by their union (*the body of the fornix*) lies immediately under the corpus callosum. Posteriorly it again divides into

two diverging bands of fibres (*the posterior pillars of the fornix*), which pass out along the floor of the lateral ventricles between the corpus striatum and the hippocampus major. (Plate VII., B and C.)

Cut across the posterior pillars of the fornix and hippocampus major, and reflect them.

8. The **Optic Thalamus** is the rounded prominence immediately below the hippocampus major and the posterior pillars of the fornix. It lies just anterior to the corpora quadrigemina. The optic tracts pass over its lateral surface.

9. The **Corpus Geniculatum** is a small, prominent elevation, just posterior to the optic tract and between it and the corpora quadrigemina.

10. The **Foramen of Munro** is a narrow, slit-like opening, lying between the descending pillars of the fornix and the optic thalamus. This passage, together with its fellow of the opposite side, forms a Y-shaped canal, connecting the two lateral ventricles with a median cavity, already mentioned, the third ventricle.

Remove the portion of the corpus callosum remaining between the posterior pillars of the fornix, being careful not to injure the delicate membrane immediately below.

11. The **Velum Interpositum** is the thin membrane forming the roof of the cavity (third ventricle)

behind and below the body of the fornix. The margins of this membrane are very vascular, and are known as the choroid plexuses. These plexuses are continued through the foramina of Munro to form the choroid plexuses of the lateral ventricles. The velum is somewhat thickened posteriorly to form the *pineal gland*. (Plate VII., c.)

12. The **Third Ventricle**, before mentioned, is the very narrow cavity of the brain lying between the optic thalami. It is bounded above by the velum interpositum, and below by the lamina cinerea, corpora albicantia, crura cerebri, and the infundibulum, and with the cavity of the latter it is continuous. It opens anteriorly into the two lateral ventricles through the foramina of Munro. (Plate VII., c.)

Make a median, vertical, longitudinal section through the remaining portion of the brain.

13. The **Anterior Commissure** is a delicate transverse band of fibres, passing between the two hemispheres, in front of the anterior pillars of the fornix. It connects the two corpora striata. The lamina cinerea passes between it and the optic chiasma. (Plate VII., c.)

14. The **Middle or Soft Commissure** is a much larger band of transverse fibres and cells connecting the optic thalami. It passes across the upper part of the third ventricle. (Plate VII., c.)

15. The **Posterior Commissure** joins the dorsal por-

tions of the optic thalami, and forms the posterior wall of the third ventricle, just in front of the corpora quadrigemina. (Plate VII., c.)

16. The **Aqueduct of Sylvius** is the narrow canal passing posteriorly from the third ventricle, beneath the corpora quadrigemina and above the crura cerebri. (Plate VII., c.)

17. The **Fourth Ventricle** is the cavity of the brain posterior to the aqueduct of Sylvius, bounded above by the valve of Vieussens and the cerebellum, and below and laterally by the medulla oblongata. It is continuous posteriorly with the *central canal* of the spinal cord. (Plate VII., c.)

18. The **Arbor Vitæ** is the name given to the branching structure of white matter in the cerebellum. It is best seen in the section just made. (Plate VII., c.)

DISTRIBUTION OF THE CRANIAL NERVES.

1. The **Olfactory Nerves** (I.) are delicate fibres which arise from the olfactory lobes of the brain, pass through the ethmoid bone, and are distributed to the Schneiderian membrane of the nose.

2. The **Optic Nerve** (II.) passes through the optic foramen, and enters the posterior surface of the eyeball.

3. The **Oculo-motor Nerve** (III.) passes through the sphenoidal fissure of the skull, and is distributed to certain muscles of the eyeball (superior, inferior,

and internal recti, and inferior oblique) and the levator muscle of the lid.

4. The **Pathetic Nerve** (IV.) passes through the sphenoidal fissure to another muscle (superior oblique) of the eyeball.

5. The **Trigeminal Nerve** (V.), soon after it emerges from the brain, enlarges into the *Gasserian ganglion*. It then separates into three divisions: the *ophthalmic*, which passes through the sphenoidal fissure and is distributed to the lachrymal gland, upper lid, and conjunctiva of the eye, and the skin of the nose and forehead; the *maxillary*, which passes through the foramen rotundum and supplies the lower eyelid, side of the nose, upper teeth, and the roof of the mouth and pharynx; and the *mandibular*, which passes through the foramen ovale and supplies the muscles and skin of the side of the head, muscles of mastication, lower lip, teeth, salivary glands, and inside of the mouth.

6. The **Abducens Nerve** (VI.) passes through the sphenoidal fissure and supplies muscles of the eyeball.

7. The **Facial Nerve** (VII.) passes through the stylo-mastoid foramen and supplies the muscles of the face and head.

8. The **Auditory Nerve** (VIII.) enters the internal auditory meatus and is distributed to the internal ear.

9. The **Glosso-pharyngeal Nerve** (IX.) emerges

from the jugular foramen of the skull, and is distributed to the root of the tongue, soft palate, and pharynx.

10. The **Vagus Nerve (X.)** also emerges from the jugular foramen. It has two ganglia, one within the skull, at the point where it enters the foramen, and another, outside the skull, a short distance beyond the foramen. The nerve passes down the neck, between the internal jugular vein and the carotid artery, enters the thorax, and there passes along the œsophagus and posterior mediastinum. It sends branches to the following organs: pharynx, larynx, heart, lungs, œsophagus, stomach, liver, and spleen.

11. The **Spinal Accessory Nerve (XI.)** passes anteriorly along the side of the spinal cord, enters the skull by the foramen magnum, and again emerges from the jugular foramen in two branches. One branch fuses with the vagus nerve at the first ganglion of the latter; the other branch is distributed to the sterno-mastoid and trapezii muscles.

12. The **Hypoglossal Nerve (XII.)** leaves the skull by the anterior condyloid foramen, passes back to the lower side of the digastric muscle, then forward above the hyoid bone to the under side of the tongue.

SPINAL CORD.

The **Spinal Cord** is the posterior continuation of the medulla oblongata, which lies in the neural

canal of the spinal column. It is composed, as is the medulla, of an inner core of gray matter and of external columns of white fibres. A median longitudinal fissure extends along both the mid-dorsal and mid-ventral lines. In the brachial and lumbar regions the cord becomes somewhat broadened, to form the *cervical* and *lumbar enlargements*. In the sacral region the cord ends in a small nerve-filament, the *filum terminale*. The filum terminale, together with the sacral nerves, which lie parallel with each other for some distance in the vertebral canal, form the *cauda equina*.

SPINAL NERVES.

The **Spinal Nerves** each arise from the spinal cord by a dorsal and ventral root, and pass out from the neural canal through an intervertebral foramen. The dorsal root bears a ganglion. After emerging from the neural canal, each nerve divides into a dorsal and ventral branch.

A.—**Brachial Plexus.** (Plate VII., D.)

The **Brachial Plexus** is the net-like arrangement formed by the union of the ventral divisions of the sixth, seventh, and eighth cervical and first thoracic nerves. Its branches supply the region of the shoulder and arm. The principal nerves arising from the brachial plexus are :

1. A small nerve, which supplies the **rhomboides** muscle.

2. The **Suprascapular Nerve**, which supplies the supra- and infra-spinatus muscles.

3. Several **Subscapular Nerves**, which supply the subscapular, teres major, and latissimus dorsi muscles.

4. The **Musculo-cutaneous Nerve**, which supplies the biceps, the brachialis anticus, and coraco-brachialis muscles, and the skin of the outer side of the fore-leg below the elbow.

5. The **Circumflex Nerve**, which passes between the subscapular and teres major muscles, and supplies the deltoid and teres minor muscles and the skin of the shoulder.

6. The **Musculo-spiral Nerve**, which winds around the humerus and is distributed to the skin and muscles of the fore-leg.

7. The **Median Nerve**, which passes through the internal condyloid foramen and supplies muscles on the ventral side of the fore-leg.

8. The **Ulnar Nerve**, which is distributed to the muscles and skin of the fore-leg.

9. The **Internal Cutaneous Nerve**, which supplies the skin on the inner side of the fore-leg.

10. The **Anterior Thoracic Nerve**, which supplies the pectoral muscles and part of the latissimus dorsi muscle.

B.—**Lumbar Plexus.** (Plate VII., E.)

The **Lumbar Plexus** is composed of the ventral divisions of the fourth, fifth, sixth, and seventh

lumbar, and first sacral nerves. Its branches are distributed to the regions of the pelvis and hind-leg. The principal nerves arising from the lumbar plexus are :

1. The **Ilio-hypogastric Nerve**, which supplies the skin of the abdomen.

2. The **Ilio-inguinal Nerve**, which supplies the skin of the inguinal region and external generative organs.

3. The **Genito-crural Nerve**, which passes beneath Poupart's ligament and supplies the skin of the thigh and the spermatic cord.

4. The **External Cutaneous Nerve**, which also passes beneath Poupart's ligament and supplies the skin of the hip and thigh.

5. The **Anterior Crural Nerve**, which passes down the front of the thigh and supplies the skin and muscles of the thigh and leg.

6. The **Obturator Nerve**, which passes along the side of the pelvis and through the obturator foramen.

7. The **Great Sciatic Nerve**, the largest nerve of the body, which passes through the sacral sciatic notch, between the tuberosity of the ischium and the great trochanter of the femur, and then down the hind-leg to innervate the thigh, leg, and foot.

8. The **Lesser Sciatic Nerve**, which supplies the muscles of the back of the hip and thigh.

9. The **Caudal Nerve**, which runs down the side of the tail and supplies its muscles.

SYMPATHETIC SYSTEM.

The **Sympathetic Nervous System** consists, first, of a delicate, double chain of ganglia, extending along the ventral side of the spinal column from the head to the tail, and, secondly, of numerous branches and ganglia throughout the body. The branches of both divisions are distributed to the viscera and blood-vessels. In the head they communicate with many of the cranial nerves, and in the trunk with the spinal nerves.

In the thorax the two sympathetic cords may be seen lying along the line of the heads of the ribs, between the pleura and intercostal blood-vessels. In the lumbar region the cords lie nearer together on the bodies of the vertebræ, at the inner margins of the psoas muscles. In the sacral region the cords unite in a single ganglion.

There are three plexuses of nerves and ganglia connected with the sympathetic system :

1. The **Cardiac Plexus** lies at the base of the heart on the aorta and pulmonary artery. It receives branches from the vagus and cervical sympathetic ganglion, and innervates the heart.

2. The **Solar Plexus** lies between the adrenal bodies, stomach, aorta, and crura of the diaphragm. It receives branches from the vagus, cardiac plexus, and sympathetic cords, and sends nerves to the abdominal viscera.

3. The **Hypogastric Plexus** lies between the right and left iliac arteries. It receives branches from the solar plexus and lumbar part of the sympathetic cords, and sends branches to the pelvic viscera.

CHAPTER VI

EYE

APPENDAGES OF THE EYE.

1. The **Eyelids** are two folds of skin, one dorsal, one ventral, which guard the anterior portion of the eyeball. There are no "eyelashes," but the whole external surface of the lid is covered with hair. The inner surface of the lid is covered with mucous membrane, which is continuous over the front of the eyeball, and is known as the *conjunctiva*. The angles where the two eyelids meet are known respectively as the *inner canthus* and *outer canthus* of the eye.

2. The **Puncta Lachrymalia** are two small openings situated on each eyelid a short distance from the inner canthus. They open into two *lachrymal canals*, which unite to form the *lachrymal duct*, which opens into the nasal cavity.

3. The **Meibomian Glands** are the parallel rows of yellowish glands situated on the inner surface near the edge of each lid.

4. The **Nictitating Membrane**, or "third eyelid," is a large fold of membrane arising from the inner canthus of the eye, between the lids and the eye-

ball. It consists of folds of conjunctiva, strengthened by a cartilage at its free margin.

5. The **Harderian Gland** is a small gland situated on the nictitating membrane.

6. The **Lachrymal Gland** lies in the upper and outer part of the orbit, between the wall of the orbit and the eyeball. Its duct opens on the inner surface of the upper eyelid, just above the outer canthus.

Remove the zygomatic arch and the underlying muscles, cut away the coronoid process of the mandible, and expose the lateral surface of the eyeball, being careful not to disturb its attachment.

7. The **External Rectus Muscle** of the eyeball arises from the wall of the orbit just external to the optic foramen. It is inserted on the outer (lateral) surface of the eyeball.

8. The **Inferior Rectus Muscle** arises from the ventral margin of the optic foramen, and is inserted on the ventral side of the eyeball.

9. The **Inferior Oblique Muscle** arises from the orbital process of the maxillary bone, and is inserted on the eyeball, on its ventral and outer side, along the edge of the external rectus muscle.

10. The **Internal Rectus Muscle** arises from the inner margin of the optic foramen and is inserted on the inner side of the eyeball.

11. The **Superior Rectus Muscle** arises from the

dorsal margin of the optic foramen and is inserted on the dorsal surface of the eyeball.

12. The **Superior Oblique Muscle** arises from the margin of the optic foramen. Nearly opposite the middle of the eyeball it becomes tendinous, and passes through a fibro-cartilaginous ring, situated on the inner dorsal side of the orbit; it then passes toward the eyeball and is inserted on the dorsal side, at right angles to the insertion of the superior rectus muscle.

13. The **Choanoid Muscles** arise around the optic foramen and are inserted on the circumference of the eyeball, within the insertion of the recti muscles.

EYEBALL.

Remove the eyeball from the orbit by cutting through the muscles and optic nerve. Dissect off the fat and other tissues adhering to its surface.

1. The **Sclerotic Coat** is the white, opaque portion of the external coat of the eye. It is pierced by the optic nerve, near the middle point of its posterior surface. The sclerotic coat is composed of smooth, white, fibrous tissue, and gives solidity to the eyeball.

2. The **Cornea** is the transparent anterior portion of the external coat. Its outer surface is covered by the conjunctiva.

Divide the eye into an anterior and posterior half.

3. The **Vitreous Humor** is the transparent, jelly-like mass filling the posterior chamber of the eye, which has now been exposed.

4. The **Retina** is the innermost of the three coats of the eye. It is a delicate membrane formed by the expansion of the optic nerve on the interior of the eye. The *optic disc*, or blind spot, is the small, white, round area at the point where the optic nerve pierces the sclerotic and choroid coats and expands into the retina. The blood-vessels supplying the retina radiate from the blind spot.

5. The **Choroid** is the thin coat of the eye lying between the sclerotic and the retina. It is of a dark color, owing to the pigment which is everywhere present, except in a circular area on the back of the choroid, around and above the entrance of the optic nerve. This spot is of a lighter color, and is known as the *tapetum*.

6. The **Ciliary Processes** are the irregular folds into which the choroid is thrown at the margin of the cornea.

7. The **Ora Serrata** is the anterior toothed margin of the retina. It lies around the periphery of the ciliary processes.

8. The **Crystalline Lens** is a transparent, double convex body, situated in front of the vitreous humor. It is more convex anteriorly than poste-

riorly. The lens is enveloped in a thin, transparent membrane, known as the *capsule of the lens*.

9. The **Suspensory Ligament** is a very delicate membrane attached to the capsule at the edge of the lens. It suspends the lens from the ciliary processes.

10. The **Ciliary Muscle** is a ring of radiating muscular fibres, arising from the sclerotic at the edge of the cornea and passing backward to the choroid opposite the ciliary processes. By its contraction the lens is made more convex.

11. The **Iris** is the anterior portion of the choroid. It forms a perforated circular disc at the front of the crystalline lens. The perforation is known as the *pupil*.

12. The **Aqueous Humor** is the fluid filling the anterior chamber of the eye, between the lens and the cornea.

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